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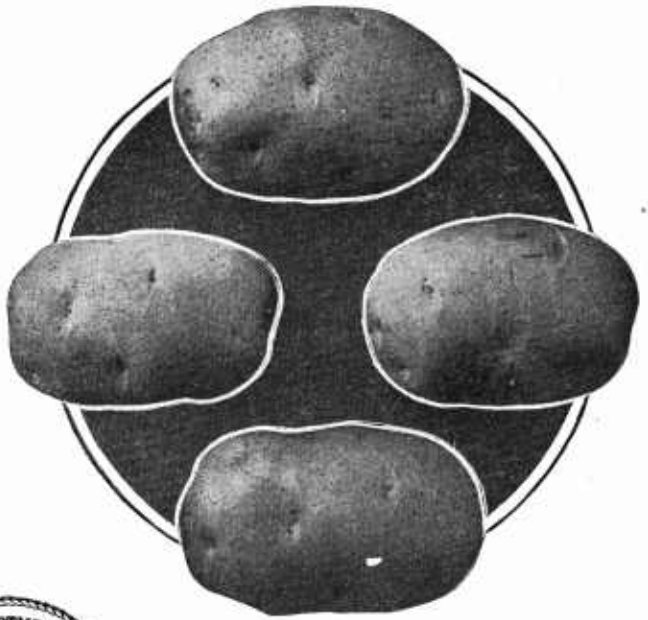
SEED POTATOES AND HOW TO PRODUCE THEM



THE AVERAGE PRODUCTION per acre of potatoes in the United States is very much lower than in Canada, Great Britain, and European countries outside of Italy.

One of the reasons for the lower production in the United States is that less attention has been given to the character of the seed. Good seed is one of the determining factors in the production of maximum crops of potatoes.

The use of high-grade seed would increase the returns from the potato crop of the country by many millions of dollars.

The quality of the seed may be improved through the removal of all diseased, weak, or off-type plants as soon as they are observable.

Only seed from productive plants should be used.

Careful attention should be given to securing seed that is free from varietal mixture and that is true to type.

Good seed can not be produced unless the growing plants are given good cultural attention.

As a rule the quantity of seed used is not sufficient to produce a maximum crop.

From 15 to 18 bushels of seed should be used per acre instead of 9 to 11, as at the present time.

All seed stock should be disinfected before planting.

Good storage conditions are essential to insure sound, firm seed at planting time.

This bulletin is a revision of and supersedes Farmers' Bulletin 533, Good Seed Potatoes and How to Produce Them.

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SEED POTATOES AND HOW TO PRODUCE THEM.

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CONTENTS.

YIELDS OF POTATOES.

A STUDY of the statistical data upon potato crop production in the United States for the last 55 years[1] reveals the interesting fact that relatively little gain in production per acre has been made during this period. To partially minimize seasonal variations in yield per acre the 55-year period has been divided into eleven 5-year cycles and the average production of each cycle compared. During the first 5-year cycle, 1868–1872, the average yield per acre was 94.5 bushels, while in the last 5-year period it was 98.7, or a gain of approximately 4.4 per cent. The averages for the eleven 5-year cycles are 94.5, 88.1, 77.9, 76.7, 74.0, 79.9, 82.2, 96.3, 96.5, 96.0, 98.7 bushels per acre, respectively. A study of these data shows that there was a very appreciable and more or less gradual decline in production per acre during the second, third, fourth, and fifth cycles, or from 1875 to 1892, inclusive, and that during the next three cycles there was a decided increase, the fifth cycle showing a slight increase over the first cycle. From this period until 1908 to 1922 the increase has been a very nominal one, unless we choose to regard the 1918 to 1922 performance as indicating a permanent improvement in the per acre production of potatoes. From the data presented it is evident that the slight gain in average yield per acre (4.4 per cent) in the last of the eleven 5-year cycles over that of the first cycle is not sufficient to account for the increased production of potatoes in the United States. The total average bushel production in the United States for the years 1868 to 1872 was 117,745,800, while in the last 5-year period (1918–1922) the average production was 390,173,200 bushels, or an increase over the first period of more than 231 per cent. During

[1] The statistical data upon which these studies are based were obtained for the years 1868 to 1888 from the United States Department of Agriculture Yearbook for 1917, p. 657; for 1889 to 1895 from the 1920 Yearbook, p. 617; for 1896 to 1920 from the 1921 Yearbook, p. 583; and for 1921 to 1922 from the December 23, 1922, issue of the United States Department of Agriculture Weather Crops and Markets publication, p. 565.

this same period the increase in acreage devoted to potato production has been more than 217 per cent. These data show conclusively that increased production in the United States during the last 55 years has been almost entirely due to increased acreage rather than to any material improvement in cultural practices resulting in larger yields per acre.

Table 1 shows and the accompanying diagrams (Figs. 1 to 4) also show in a graphic way the average acre yields, the farm price per bushel, the acreage grown, the total production of potatoes, and also the population of the United States during the eleven 5-year cycles studied. In the construction of these diagrams it has not been feasible to employ the same scale in any two of them, owing to the great difference in the magnitude of the figures treated. A careful study of the first diagram (Fig. 1), in which the acreage yield and farm price per bushel are given, shows that the acreage-production curve, if drawn on the chart, would somewhat resemble the curve of a scimitar blade, in which the extreme ends of the blade represent the maximum yields for each half of the curve.

TABLE 1.—*Averages of acreage, production, and farm values of potatoes in 5-year periods from 1868 to 1922, inclusive.*

5-year period.	Number of acres.	Production (bushels).		Farm value on Dec. 1.	
		Total.	Per acre.	Total.	Per bushel (cents).
1868 to 1872	1,246,200	117,745,800	94.5	$64,123,600	54.5
1873 to 1877	1,529,800	134,773,200	88.1	68,665,600	50.9
1878 to 1882	1,934,200	150,706,200	77.9	85,547,200	56.8
1883 to 1887	2,284,000	175,197,800	76.7	82,295,000	46.9
1888 to 1892	2,633,800	194,939,400	74.0	93,012,600	47.7
1893 to 1897	2,900,400	231,757,800	79.9	95,258,400	41.1
1898 to 1902	2,968,200	243,866,400	82.2	117,671,600	48.3
1903 to 1907	3,213,200	309,568,200	96.3	170,652,800	55.1
1908 to 1912	3,644,400	351,793,800	96.5	213,038,200	60.6
1913 to 1917	3,812,400	366,045,600	96.0	322,292,400	88.0
1918 to 1922	[1] 3,953,200	[1] 390,173,200	98.7	425,826,000	109.1

[1] The data for 1922 are subject to revision.

The gradual decline in yields during the first half of this period is thought to be largely due to the following factors:

The ravages occasioned by the Colorado potato beetle during the early period of its invasion of the eastern United States.

The financial depressions of 1877 and 1893, which brought about a well-marked decline in agriculture in New England, New York, and the other heavy potato-producing areas of the northeastern United States.

A gradual depletion of soil fertility.

Of the factors which have checked the downward tendency and contributed most largely toward a return to the old production level the following are thought to have been most potent:

The influence of the agricultural experiment stations, agricultural colleges, and the United States Department of Agriculture through experimentations, demonstration, and the dissemination of literature.

The influence of the Bordeaux-mixture treatment in the control of fungous diseases affecting the potato.

The development of special potato-growing sections, as, for example, Aroostook County, Me., the Atlantic Coastal Plain trucking region, the Greeley and Carbondale districts of Colorado, and many other areas, in which the average yield is approximately from two to three times the general average for the United States.

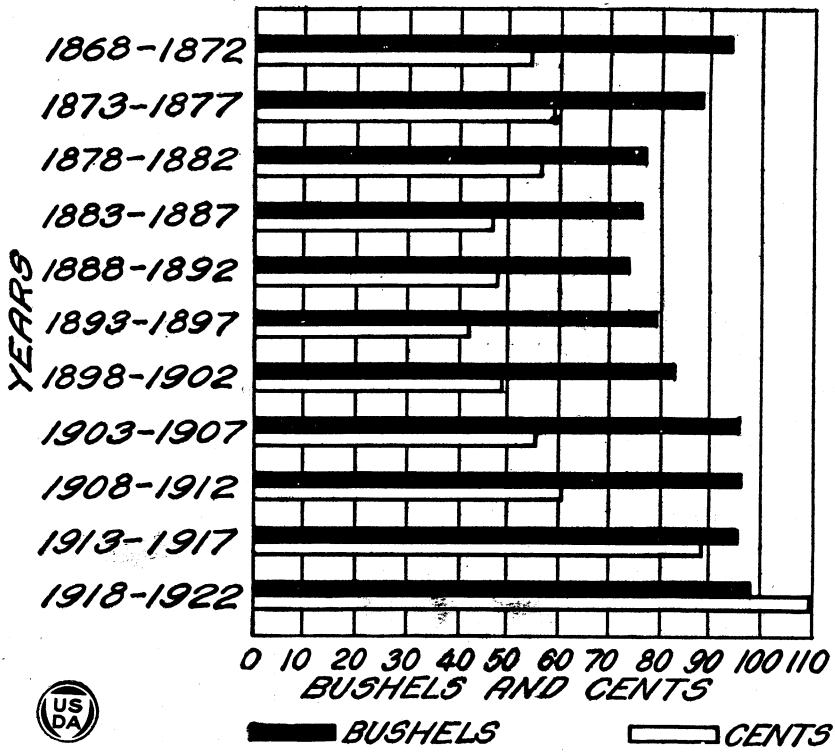

FIG. 1.—Diagram showing the average number of bushels per acre and the average farm price per bushel of potatoes grown in the United States by 5-year periods from 1868 to 1922.

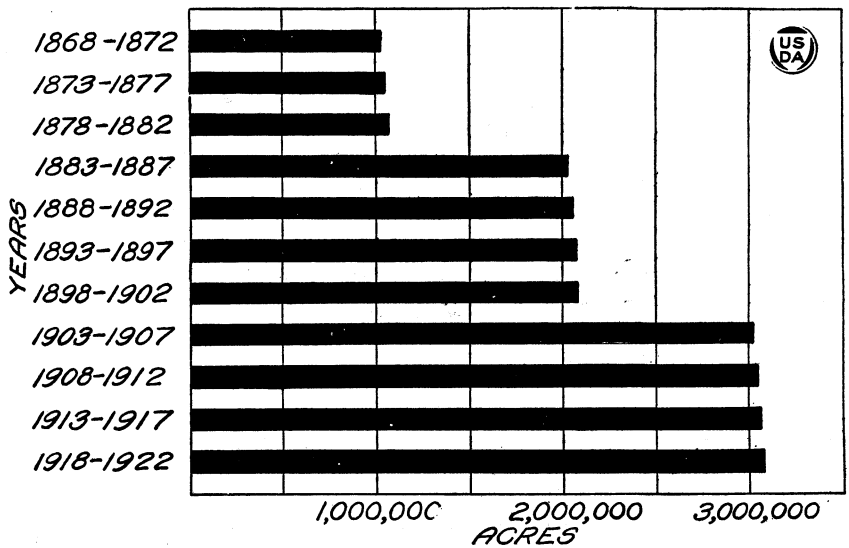

FIG. 2.—Diagram showing the average potato acreage of the United States by 5-year periods from 1868 to 1922.

Figures 1 to 4 show a comparison of the relation of increased production to a constantly increasing population. The diagrams show that under normal conditions production is keeping pace with population. Crop shortages are, therefore, the result of abnormal or unfavorable conditions.

In comparing the average crop production of potatoes in the United States with that of Great Britain, one is impressed with the fact that

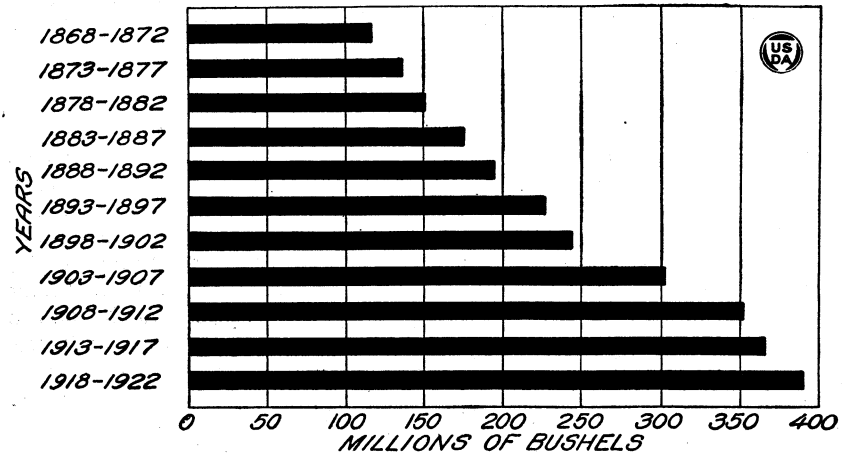

FIG. 3.—Diagram showing the average potato production of the United States by 5-year periods from 1868 to 1922.

generally speaking we have much yet to learn before we can raise our average to that of that country. During the years 1901 to 1910, inclusive, the average acre yield in Great Britain was approximately 200 bushels, while that in the United States was not quite 93 bushels.

Of the many causes which produce a low average potato yield in this country, poor seed is thought to be important. The American

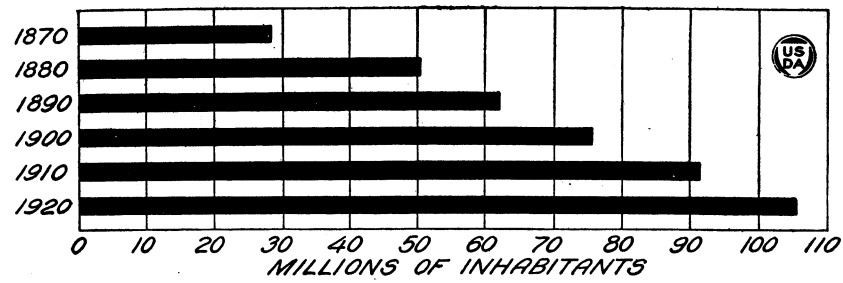

FIG. 4.—Diagram showing the population of the United States by decades from 1870 to 1920.

potato grower pays too little attention to his seed potatoes. European growers pay very strict attention to the quality and quantity of seed they use. This has led to the differentiation of the potato growers into seed and crop specialists. The seed specialist makes a business of producing high-quality seed, while the crop specialist produces a high-grade table potato. Until rather recently no such differentiation, at least to any marked extent, could be claimed in

this country. However, with the adoption of seed-potato inspection and certification in California, Colorado, Idaho, Kentucky, Maine, Maryland, Michigan, Minnesota, Montana, Nebraska, New Hampshire, New Jersey, New York, Oregon, Pennsylvania, South Dakota, Utah, Vermont, Washington, Wisconsin, and all of the Canadian Provinces, groups of seed-potato growers are gradually being evolved. A further stimulus to those who are engaged in the production of seed potatoes is the increasing demand for good seed stock at prices which are sufficiently remunerative to well repay the grower for the extra care given to the crop.

WHAT CONSTITUTES GOOD SEED.

The question of what constitutes good seed is a vital one, and possibly no two persons would fully agree in every particular upon this point. Good seed may be defined as follows: Somewhat immature tubers—reasonably uniform in size and shape, with skin bright and free from scab—firm and sound, with first sprouts just starting. Seed of such quality when given suitable cultural conditions can be relied upon to produce a remunerative crop, other things being favorable. If in any given year it were possible to plant the entire potato acreage of the United States with first-class seed stock the total production would be increased from 10 to 25 per cent. Based on the average production for the 5-year period from 1918 to 1922, this increase would represent from 39 to 97½ million bushels, or an increase in money value of $40,333,000 to $106,333,000.

PURE SEED.

The importance of securing pure seed of a given variety is best appreciated by the southern truck grower, who at the present time is practically dependent on northern-grown seed potatoes for his early crop. In the past, though not to so great an extent at the present time, it has frequently happened that Irish Cobbler seed potatoes have contained 5 or more per cent of varietal mixture. As a rule this mixture consists of a late-maturing variety, generally the Green Mountain, which sets and matures its tubers at a later date than the Irish Cobbler and in consequence is not ready to harvest when the bulk of the crop is fit for marketing. The truck grower aims to harvest his crop as soon as most of the tubers have reached a merchantable size. It requires little imagination to see that the grower is a direct loser in proportion to the percentage of mixture in the seed planted. If his yield is 40 to 75 barrels per acre with a 5 per cent mixture he has sustained a gross loss of 2 to 3¾ barrels per acre, or double this quantity if a 10 per cent mixture occurs. Usually the price of early potatoes ranges from $3 to $5 per barrel, the highest price being obtained for the first lots harvested. Assuming that the crop sells at an average of $4 per barrel, the gross loss on the lowest yield would be $8 and on the highest $15 per acre. It is apparent, therefore, that every care should be exercised in securing seed stock free from varietal mixture.

UNIFORMITY IN SIZE AND SHAPE OF TUBERS.

Under normal conditions of growth many present-day commercial varieties are very variable in size and shape of tuber. To some extent both size and shape are determined by the character of the soil, rate of planting, fertilization, and cultural care given the growing crop. Inheritance, however, plays a very important part. Most varieties contain within themselves distinct varietal strains which when isolated are much more uniform in respect to size and shape than the variety itself. Other things being equal, the variety or varietal strain that produces the greatest number of fair-sized shapely tubers and the smallest number of ill-shaped and small tubers should prove the most valuable, because it involves less waste to both the grower and the consumer. It is particularly important at present that such strains be developed, because there is an increasing demand for fancy table stock to satisfy the requirements of a large and discriminating class of consumers who are insisting on greater uniformity in size and shape and are willing to pay a premium on such grades.

DEVELOPMENT OF HIGH-GRADE SEED POTATOES.

The successful production of high-grade seed potatoes is very largely dependent upon the following factors: *(1) Starting with a good strain; (2) the proper treatment of the seed; (3) thorough preparation and proper fertilization of the soil; (4) the following of the best cultural practices, including protection against insect and fungous pests; (5) the elimination of all mixtures and all diseased or weak plants; and (6) the careful harvesting and proper storage of the crop.*

SECURING A GOOD STRAIN OF SEED.

If the strain of seed you are using is lacking in vigor, it is generally advisable to discard it and purchase a new lot from some reliable grower whose stock you have reason to believe is superior to yours. This suggestion is made as the result of a rather wide experience in trying to improve poor strains of potatoes through selection methods. Such attempts have usually resulted in failure, and it is felt that as a rule much more satisfactory progress can be made by starting with a new strain. Further improvement can usually be secured through selection.

SEED-POTATO IMPROVEMENT BY SELECTION.

The improvement of seed potatoes by selective processes has long engaged the attention of the potato grower. Recent experimental evidence seems to indicate that the possibilities of improving potato seed stock by selective processes alone are not as great as many writers upon this subject have claimed. To those who have devoted much time and effort to the improvement of the potato by selection it would appear that the chances of finding superior yielding true-to-type strains within a variety are not as great as has been believed. The chief advantages to be derived from seed-potato selection practices are the elimination of diseased and weak plants and the removal of varietal mixtures.

IMPROVEMENT PRACTICES.

Five improvement practices may be used in securing a high-yielding and commercially desirable strain of potatoes: (1) The tuber-unit method, (2) hill selection, (3) mass selection, (4) field roguing, and (5) strain testing.

In early editions of Farmers' Bulletin 533 considerable emphasis was laid upon the tuber-unit method of seed-potato improvement; subsequent experiences of the writer and others have indicated that this method is not as satisfactory or as practical in operation as the other four methods suggested. It is thought desirable, however, to briefly describe the tuber-unit method because some of its processes are applicable to other selection methods.

TUBER-UNIT METHOD.[2]

The tuber-unit method, as now generally understood, consists in selecting from the seed bin before planting time a considerable number of the most perfectly shaped tubers ranging from 6 to 8 ounces in weight. When planted, these tubers are quartered, as dropped, into four as nearly equal parts as possible, by splitting the bud-eye cluster twice from seed to stem end of the tuber. In other words, the tuber is cut through its longitudinal axis. The four pieces of each tuber are dropped consecutively in the row at a distance of from 10 to 12 inches apart in the furrow. All tubers showing discoloration of the flesh or other evidence of disease should be rejected. By allowing an additional spacing between each set of fours, the four plants from each tuber are definitely isolated from adjoining ones and the grower can readily observe any variation in vigor and uniformity between the various units planted. This method also enables him to detect any mixtures that may occur in the variety. All mixtures should at once be removed. By marking the units which appear to be the most uniform in size, vigor, and type when the plants are still in vigorous growth, the first step in selection has been accomplished. At digging time the product of each unit is separately harvested and a further selection made from the marked units of all tubers which most nearly approach the size, shape, and smoothness desired. The selected tubers of each unit should be separately placed in small sacks, preferably cotton or burlap, numbered with both field and unit numbers, and stored to await further examination. The final examination should produce data on the number and weight of merchantable and unmerchantable tubers and their general conformity in size, shape, and smoothness of the type desired. From each of the units retained 10 of the best tubers should be selected for the next season's planting.

It is desirable to maintain the study of each selection on the tuber-unit basis the following season, because it permits a more accurate comparison of the behavior of each. The 10 selected tubers from each original unit will give 40 plants for study the second year. All selections which do not produce a reasonably uniform lot of plants should be marked for rejection. At harvest time the progeny of each selec-

[2] For further information concerning the arrangement of a tuber-unit selection plat and a convenient system of note taking, see Stuart, William, The "tuber-unit" method of seed-potato improvement. U. S. Dept. Agr., Bur. Plant Indus. Cir. 113, pp. 25–31, 2 fig. 1913.

tion should be kept by itself and the same data recorded as those taken on the crop grown from the original tuber unit. Only the product from such 40-hill rows as meet the most rigid requirements should be retained. The further conduct of the work will consist in the multiplication of the selected strains for field planting and the elimination of weak plants.

HILL SELECTION.

The hill-selection method consists in marking the most promising plants during the growing season and at harvesting time saving only those which give the greatest promise. (Figs. 5 and 6.) The progeny of each hill should be kept separate and the same data taken as outlined for the tuber unit. Plant on the tuber-unit or progeny-

FIG. 5.—Progeny of a mosaic-infected potato plant of the Triumph variety on the left (*A*) and of a healthy plant on the right (*B*). Bin selection of such seed would result in taking at least two tubers from the mosaic plant. If small tubers were used all would come from diseased plants. In hill-selection work the progeny of plant B should be saved.

row basis the following season. For the sake of uniformity a definite number of tubers (five or more) should be planted from each hill selection. From this point on, follow the methods given in tuber-unit work.

MASS SELECTION.

Mass selection differs from hill selection in only one respect, which is that the tubers from the individually selected plants are not kept separate. Generally those who practice mass selection do not go to the trouble of marking promising individual plants during the growing season, but simply go through the field before harvesting the whole crop and dig by hand as many plants as may be desired to secure the necessary quantity of seed that show the desired vigor and stem characters thought to be correlated with productiveness, trueness to type, and uniformity in size of tubers of the particular variety grown.

FIELD ROGUING.

Improvement of the seed stock through field roguing consists in the removal of all diseased, weak, off-type, or varietal-mixture plants during the growing season. The successful removal of such plants does not necessarily involve an intimate knowledge of the various diseases affecting the potato, but it does require that the person doing the roguing be able to tell whether a plant is normal or abnormal in appearance. A sufficient field area should be rogued the first year to provide the quantity of seed necessary to plant the full acreage to be grown the ensuing season. The area to be rogued should be gone over at least three times during the growing season, to insure the removal of all plants affected with transferable diseases, such as mosaic and leaf-roll, as soon as their presence can be detected. In the field-roguing method no attempt is made to select the progeny of individual plants at harvesting time, the whole crop being dug and all desirable seed stock gathered and stored in bulk.

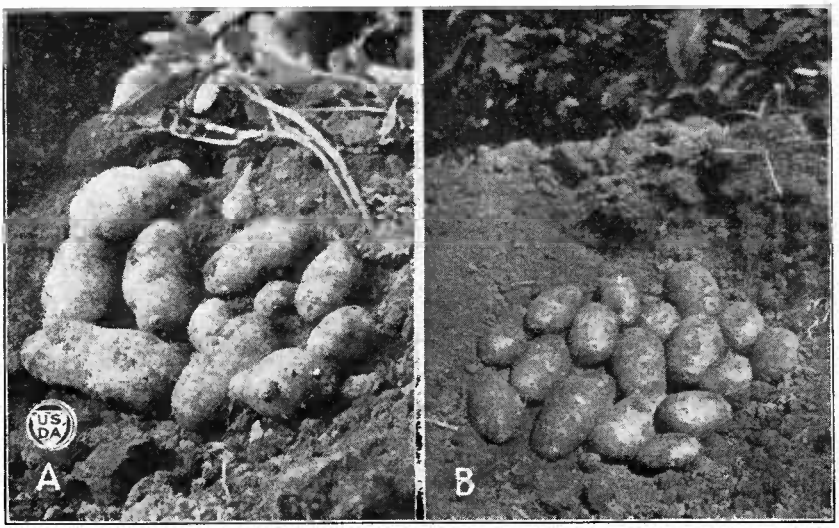

FIG. 6.—Progeny from abnormal (*A*) and normal (*B*) plants of the Russet Burbank potato. Plant A is known in the West as a degenerate or run-out plant, and the disease with which it is affected is probably identical with that recently termed "spindle tuber." It is a communicable disease and may become serious. In hill-selection work the progeny of plants such as *B* should be saved.

STRAIN TESTING.

The improvement of seed potatoes by the strain test, or, as it might more properly be termed, the "source-of-seed test" method, consists in securing as many as possible desirable lots of seed stock of the same variety from different growers throughout a given district or State, or even from various States, and carefully studying their behavior when grown side by side under identical soil and cultural conditions. Experimental studies by this method of seed improvement have demonstrated that some lots or strains of seed stock are far superior to others; in fact, differences in yield of more than 100 bushels per acre have been noted between the lowest and highest yielding strains. Furthermore, it has been conclusively demonstrated by numerous trials that these yields were not accidental, but that in practically every instance the high-yielding strains have consistently given larger yields wherever tested.

The improvement of seed stock by this method does not consist in the actual isolation and development of a strain from a given variety, but rather in locating, as it were, by comparative tests the really superior sources of seed stock. The actual improvement accomplished is measured by the success attending one's efforts in getting live, up-to-date growers to discard their inferior strains and purchase the superior one, as shown by the tests made.

The practical operation of such a movement may be best emphasized by stating that in 1921 over 100 potato growers in Wisconsin grew seed stock of a superior strain of Triumph potatoes located in this manner in 1918.

It should be remembered that whatever selection practice is pursued the fields devoted to the production of high-quality seed must be carefully rogued if the vigor of the seed stock is to be maintained.

RELATIVE MERITS OF THE PRECEDING PRACTICES.

In the preliminary discussion of seed-potato improvement in this bulletin it is intimated that the chance of securing a superior strain of a commercial variety of potato through selective processes is not as great as earlier writers on this subject have claimed. A careful consideration of all the experimental evidence thus far presented would seem to justify the conclusion that the tuber-unit method of seed-potato improvement does not afford as satisfactory a starting point for selection work as the hill-selection method. The evidence at hand would also seem to indicate that neither of these practices is to be commended to the average grower of seed potatoes, as both methods involve an expenditure of a greater amount of time and effort in properly observing the details necessary to their successful application than can reasonably be expected of such a grower. The tuber-unit and hill-selection methods can only be recommended to those growers who have ample time or means to undertake these studies and to those experiment-station investigators who have the facilities necessary for carrying on such work.

The "mass-selection" and the "field-roguing" methods are more nearly adapted to the average grower, as neither method involves the growing and keeping separate of a large number of individual selections. Both are so simple of execution that any person of ordinary intelligence can practice them.

Strain testing involves a somewhat more elaborate plan of operation, in that it requires the purchasing and growing of several strains of a given variety under as nearly identical conditions as it is possible to supply. This method of seed-potato improvement may be best undertaken by the type of men suggested for the conduct of the tuber-unit and hill-selection systems. The average grower should avail himself of the findings of those engaging in strain testing and purchase his seed from those growers having the most desirable seed stock, as demonstrated by such tests.

REQUIREMENTS FOR SUCCESS.

The only requirements for the successful practice of the first two methods of seed selection are a reasonable degree of painstaking effort on the part of the grower, some 12-inch garden labels, a small pair of balances, a sufficient number of suitable small sacks, and a

safe place in which to store the selected tubers until required for the next season's planting. In addition to this, the grower should have a breeding plat in which each season's selections can be developed up to the point of field-planting stock. This selection or seed plat should be located at as great a distance from the commercial potato field as possible in order to secure the greatest degree of isolation that is feasible. Heretofore the problem of isolation has not received due consideration. This was largely owing to the fact that the seriousness of such diseases as mosaic, leaf-roll, curly-dwarf, streak, and spindle tuber has only recently come to be recognized. The fact that all of these diseases are readily transmitted from diseased to healthy plants through the instrumentality of plant lice, or aphids, and the further fact that as yet there is no reliable information as to the distance insects may transport these diseases suggest as complete isolation of the seed plat as possible. The ultimate success of the seed plat in so far as the elimination of tuber-borne diseases is concerned rests largely upon the ability of the grower to recognize diseased plants and the promptness with which they are removed from the seed plat and destroyed. Frequent and thorough inspections of the seed plat are necessary to insure the largest possible reduction of diseased plants and to reduce the transmission of disease from diseased to healthy plants.

SEED TREATMENT.

It is impossible to produce high-grade seed potatoes if the seed planted is infected with disease organisms capable of infecting the crop. The disinfection of the seed potatoes is therefore necessary if the best results are to follow. The two diseases for which seed potatoes are ordinarily treated are common scab and black scurf, or Rhizoctonia. The two disinfecting agents recommended for such treatment are formalin and corrosive sublimate (mercuric chlorid, or bichlorid of mercury). Formalin is as effective against the common scab as corrosive sublimate, but it does not give as good results in the destruction of the black-scurf fungus. When the latter is present on the tubers corrosive sublimate should be used. The formulas recommended for these two disinfectants are as follows:

(1) Formalin, 1 pint.
Water, 30 gallons.

(2) Corrosive sublimate, 4 ounces.
Water, 30 gallons.

If the formalin treatment is selected the seed potatoes should be soaked in this solution from one-half to 1½ hours. Recent experiments by Dr. I. E. Melhus, of the Iowa Experiment Station, indicate that an immersion of the seed potatoes for 2 minutes in a formalin solution of twice the strength mentioned heated to a temperature of 122° F. and covered for an hour after their removal from the hot liquid is just as effective as the longer treatment in the cold solution.

When the corrosive-sublimate solution is used, the length of the immersion should be governed by the condition of the tubers and their freedom from, or the severity of, the black-scurf infection. If the tubers are dormant and they are more or less infected with the sclerotia of the black scurf the treatment may be prolonged to 1½ or 2 hours. If they have started to germinate and are reasonably free from black scurf the period may be shortened to a half hour or less.

The treated tubers should on no account be allowed to come in contact with such receptacles as old sacks and barrels in which diseased seed has been handled, as they are almost certain sources of reinfection.

PREPARATION AND FERTILIZATION OF THE SOIL.

Strong, vigorous plants can not be produced on land that has been poorly prepared or that is deficient in available plant food. Seed potatoes should be grown on land that has been deeply plowed and thoroughly prepared to receive the seed. It should be well supplied with organic matter and available plant food. A clover or alfalfa sod furnishes the organic matter and considerable of the plant food. Barnyard manures or commercial fertilizers, or both, will supply the additional plant food necessary to produce a good crop.

CAREFUL CULTURAL PRACTICES.

The vigor of the seed stock produced is to a large extent dependent on the care given to the growing crop. Uniformity in the size of the tubers is to a large extent governed by the rate of planting. Closer planting should be practiced in the growing of seed than of table stock. Some growers in Aroostook County, Me., space their rows from 32 to 36 inches apart and the plants in the row 8 to 12 inches. The crop should be cultivated as frequently as may be necessary to provide the most suitable growing conditions.

Every effort should be made to protect the plants from injury by insect or fungous pests. Leaf-eating insects can be effectively controlled if the plants are thoroughly sprayed with arsenical poisons; sucking insects with contact solutions, such as kerosene emulsion and nicotine; and fungous diseases, such as the early and late blights, with Bordeaux mixture. In every operation it should be remembered that whatever contributes to the health of the plant increases the vigor of the seed stock produced.

ELIMINATION OF VARIETAL MIXTURES AND DISEASED OR WEAK PLANTS.

The vegetable-seed growers employ the term "roguing" to denote the process of removing all mixtures or off-type plants from the seed plat. As this term, when understood, is a brief and yet sufficiently descriptive way of indicating the process of eliminating all undesirable plants or "rogues," it is proposed to use it in this connection.

It is an easy matter to rogue a seed-improvement or selection plat during the growing season. Varietal mixtures are more easily detected when the plants are in bloom. Weak plants are usually apparent in the early stages of their growth, as are also certain types of diseases, such as mosaic and black-leg, although both may appear later. Plants infected with Rhizoctonia and Fusarium are usually not apparent until the latter part of the growing season. It is evident from these statements that in order to rogue the seed plat thoroughly it is necessary to make two or three examinations of the field or plat during the growing season. Further roguing should be done when the crop is harvested by discarding the progeny of all low-producing plants. (Fig. 5, *A*.)

MONETARY VALUE OF GOOD SEED POTATOES.

The producer of high-grade seed potatoes is justly entitled to a fair monetary return for the special efforts he has made to produce quality seed stock. This is especially true where a seed plat is maintained year after year and the crop has been officially inspected and passed by a duly authorized seed-certification inspection officer. Just what increase in price over ordinary stock one is entitled to receive for such efforts and for the inspection fees involved is not an easy matter to determine. It is believed that a premium of 50 cents per bushel over the market price of table stock of the same variety is ordinarily sufficient to amply repay the grower. Opinions, however, will differ upon this point. At the present time the price of certified seed stock varies all the way from $1 to $3.50 per hundredweight—60 cents to $2.10 per bushel.

IMPORTANCE OF TUBER SHAPE.

Reasonable trueness of the tubers to varietal type is generally demanded by the purchaser of certified seed. And most writers who have dealt with the subject of good seed have always placed strong emphasis upon the importance of its being true to type. Rather recently, however, some scientific as well as practical growers have been disposed to regard tuber shape as being of less importance than has been previously supposed. They have come to regard tubers that have departed from the type as a result of unfavorable environmental conditions as being satisfactory for seed purposes.

As a result of a long-continued preachment of the undesirability of slightly off-type tubers for seed purposes many cars of otherwise high-grade seed stock have been annually rejected by the southern truck grower. This is particularly true in the case of conspicuously flattened and somewhat elongated tubers of the Irish Cobbler variety. The Irish Cobbler grower in the South has come to demand roundish tubers and is suspicious of the purity of seed stock containing flattened and somewhat elongated tubers and generally protests their acceptance as strictly first-class seed stock. In fact, he is inclined to regard the off-type tubers as Green Mountain. The only obvious way of correcting these firmly rooted convictions is to demonstrate experimentally that off-type tubers resulting from unfavorable soil, cultural, or climatic conditions are no more likely to produce off-type progeny than are normal-shaped ones. This statement, however, does not apply to off-type tubers resulting from disease; such tubers should not be planted. The spindle tuber recently recognized by pathologists as a communicable disease is very similar in its method of transmission to that of leaf-roll and the mosaic disease. Figure 6, *A*, represents a fairly good example of spindle tubers. It is important, therefore, in the purchase of somewhat off-type seed potatoes to know whether the change in shape is really due to unfavorable environmental factors and not to disease.

CAREFUL HARVESTING AND STORAGE OF THE CROP.

The average grower does not fully appreciate the importance of using every means to prevent the mechanical injury of the tubers during the process of harvesting and storing. If the crop is grown on land containing a plenteous admixture of small stones the tubers are almost certain to be more severely injured in harvesting than when grown in a sandy loam soil. Hand digging is not always feasible, but it is believed that where small stones abound in the soil it will be desirable to harvest the home seed plat by hand. Much injury will be avoided if the seed stock designed for planting the field plat of the ensuing year is picked directly into crates in which it is allowed to remain throughout the storage period.

The storage conditions necessary to insure vigorous seed at planting time are more easily provided in the North than in the South. In the former region a well-constructed cellar, pit, or cave serves reasonably well. The main thing is to keep the room temperature sufficiently low to retard germination. The ideal seed tuber is one which has not wasted any of its stored-up energy by excessive loss through sprouting. (Fig. 7.) It should be firm, with the first sprouts just showing. Such tubers can be depended upon, if suitable conditions prevail, to start quickly when planted and to make a vigorous growth.

The general practice among southern growers of securing seed from the North involves in the absence of suitable storage conditions one of two things: Either getting the seed potatoes late in the fall and holding them over in dugouts, pits, or cellars, with consequent sprouting before planting, or the risk of having the seed chilled, frozen, or overheated while in transit in midwinter. In the writer's opinion the greatest need of the large southern truck grower at present is that of suitable storage facilities for handling fall shipments of seed potatoes. As a purely economic proposition the proposed change ought to commend itself. In probably nine cases out of ten the difference in first cost of these potatoes as between fall and midwinter shipments would more than offset the extra cost of storage, while the added security from danger of chilling or freezing the shipment would still further compensate the grower.

For further particulars on storage, consult Farmers' Bulletin 847, entitled "Potato Storage and Storage Houses."

LARGE COMPARED WITH SMALL SEED TUBERS.

In seasons of short production and consequent high prices for table stock, the question is frequently raised as to the advisability of using the small unsalable tubers for seed. The answer to this question is that it is always unsafe to use small tubers for seed purposes unless one is absolutely certain that they have been produced by healthy, vigorous, and productive plants. As a result of some experimental study of this question by Ballou and Gourley [3] it was found that the use of large tubers gave—

(*a*) A very heavy, perhaps almost total, percentage of the high-producing strains.
(*b*) A heavy percentage of the average or moderate-yielding strains.
(*c*) A very small percentage of the inferior or low-producing strains.

[3] Ballou, F. H., and Gourley, J. H. I. The status of the potato growing industry in Ohio. II. Seasonal notes on potatoes. Ohio Agr. Exp. Sta. Bul. 218, p. 587. 1910.

The use of small potatoes gives—

(*a*) A very insignificant percentage of the superior or high-yielding strains.
(*b*) A small percentage of the average or moderate-yielding strains.
(*c*) A very heavy, almost total, percentage of the low-yielding or inferior strains.

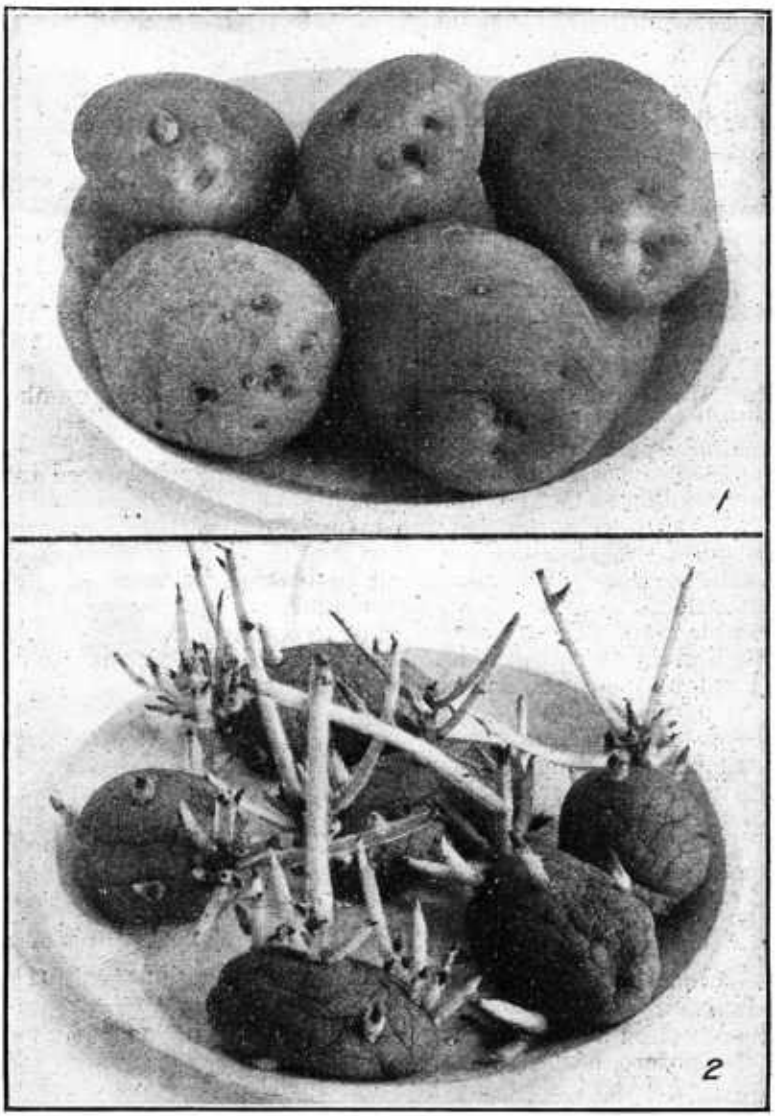

FIG. 7.—Potatoes for seed purposes, showing different stages of germination: 1, Desirable; 2, undesirable.

The use of small seed potatoes is only permissible when they are known to have been produced by strong, healthy, and productive plants. It is never advisable to use small tubers from the general mass produced from unselected stock.

WHOLE COMPARED WITH CUT SEED.

Considerable attention has been paid to the subject of whole versus cut seed at various times by the State agricultural experiment stations. The data accumulated in these investigations are for the most part conflicting in so far as they pertain to the use of whole seed. In general, the data show that within reasonable limits the larger the seed piece planted the larger is the crop produced. English and Scotch potato growers almost without exception plant whole tubers. The seed used usually runs from 1¼ to 2¼ inches in diameter, being screened out of a crop which as a rule has been grown especially for seed purposes. They are harvested before they are mature, and but a relatively small proportion of the crop exceeds the size mentioned. These growers believe that an earlier and more vigorous growth is secured from immature tubers.

Some of the reasons why European growers have adopted whole seed and are succeeding in producing profitable crops are as follows: (1) They are assured of an almost perfect stand; (2) there is greater freedom from disease; (3) the almost universal practice of germinating their seed before planting insures a minimum number of sprouts; and (4) the greater fertility of their land makes large yields of medium-sized tubers possible.

Some of the reasons for failure in the use of whole seed in this country follow: (1) The use of small tubers from unselected stock and (2) the development of too many sprouts, with a consequent large set of tubers, which, owing to lack of thorough preparation of the soil, to scant plant food, and to insufficient moisture, do not reach a marketable size, at least in sufficient numbers to produce a profitable crop. The development of too many sprouts comes about through planting tubers in a dormant condition, which under favorable soil temperature and moisture starts almost every bud into growth.

Scotch and Irish potato growers plant not less than 37 bushels of seed per acre, and frequently this quantity is greatly exceeded. The American grower, on the other hand, plants from 7 to 16 bushels per acre, with an average of 9 to 11 bushels. It is believed that the average potato production of the United States would be very materially increased if a larger quantity of seed were used.

SUMMARY.

The production of high-grade seed potatoes should be regarded as a special business.

Good seed is a determining factor in the production of maximum crops of potatoes.

Good strains of seed may be obtained by the tuber-unit, hill-selection, mass-selection, field-roguing, or strain-test methods through the process of elimination.

Like produces like. If tubers from unproductive, weak, or diseased plants are planted, a poor harvest will be reaped. Use seed from productive plants.

Purity of seed stock is an essential quality of good seed. Serious losses are sustained by the grower through mixtures.

Good seed can not be produced unless the growing plants are well cared for and the strain of seed planted was a good one.

A more liberal use of good seed would materially increase the average production per acre.

All seed should be disinfected before planting.

Experimental evidence does not indicate that whole seed is superior to cut seed, at least so far as it relates to the United States.

Good storage facilities are essential to insure sound, firm seed at planting time.

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